

**CLAIMS:**

1. In a mud pulse assembly for producing mud pulses for communicating during directional drilling data telemetry, the improvement comprising:  
a removable mud pulse generator for positioning in a landing sub body,  
5 said removable mud pulse generator having a outlet end, and  
a retainer for releasably engaging said removable mud pulse generator in said landing sub body, said retainer engaging said mud pulse generator at or upstream of said outlet end,  
said retainer being remotely operable to release said removable mud  
10 pulse generator from said mud pulse assembly.
2. The mud pulse assembly of claim 1, wherein said retainer comprises at least one detent for retention of said removable mud pulse generator, and a coupler for preventing rotation of said removable mud pulse generator relative to  
15 said landing sub body, said removable mud pulse generator being adapted to receive said detent and engage said coupler.
3. The mud pulse assembly of claim 2, wherein said at least one detent is a spring-actuated ball detent, biased towards said removable mud pulse generator.  
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4. The mud pulse assembly of claim 2, wherein said coupler comprises at least one spline on at least a portion of adjacent surfaces of said removable mud pulse generator and said landing sub body.
- 25 5. The mud pulse assembly of claim 2, wherein said coupler comprises non-circular keyed mating surfaces.
6. The mud pulse assembly of claim 1, wherein said retainer maintains said removable mud pulse generator in both a fixed spatial and fixed rotational  
30 position relative to said landing sub body.
7. The mud pulse assembly of claim 6, wherein said retainer comprises at least one detent, said at least one detent being adapted with a means for locking said removable mud pulse generator in fixed rotational position relative to said  
35 landing sub body.

8. The mud pulse assembly of claim 7, wherein said means for locking comprises at least one longitudinal spline, said spline being received by a corresponding spline on said removable mud pulse generator.

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9. The mud pulse assembly of claim 1, wherein said retainer comprises an anti-rotation latch receiver, a latch spacer and a thru-bore latch receiver, said anti-rotation latch receiver and said thru-bore latch receiver each having extended from one end a plurality of fingers, said plurality of fingers of each of  
10 said anti-rotation latch receiver and said thru-bore latch receiver interdigitating within said latch spacer, said anti-rotation latch receiver being retained in fixed position by means of bolts passing through said landing sub body and threadably engaging a key slider positioned within a recess of said anti-rotation latch receiver, said latch spacer being adapted to maintain said anti-rotation latch  
15 receiver in fixed spatial relationship relative to said thru-bore latch receiver.

10. The mud pulse landing assembly of claim 9, wherein each of said plurality of fingers of said anti-rotation latch receiver comprises a plurality of elongated longitudinal splines for mating with corresponding receiving elongated radial  
20 splines on said removable mud pulse generator, preventing rotation of said removable mud pulse generator relative to said mud pulse landing assembly.

11. The mud pulse landing assembly of claim 9, wherein each of said plurality of fingers of said thru-bore latch receiver comprises at least one detent for mating  
25 with said removable mud pulse generator, ensuring retention of said removable mud pulse generator in said mud pulse landing assembly, said removable mud pulse generator being adapted to receive said detent.

12. The mud pulse landing assembly of claim 1, wherein said removable mud pulse generator is of modular design, said removable mud pulse generator  
30 comprising a compact muleshoe, an MWD tool in a spaced-apart relationship from said compact muleshoe, and at least one leg maintaining said muleshoe body in a fixed position relative to said muleshoe body, said compact muleshoe containing a mud pulse orifice, said MWD tool containing a piston actuator and  
35 piston.

13. The mud pulse landing assembly of claim 12, wherein said muleshoe body and said at least one leg is a unitary structure.
- 5 14. The mud pulse landing assembly of claim 1, wherein said retainer further comprises a retainer actuator and receiver for receiving an actuating signal, said receiver on receiving said actuating signal acts to actuate said retainer actuator, releasing said removable mud pulse generator from said landing sub body.
- 10 15. The mud pulse landing assembly of claim 1, wherein said removable mud pulse generator can be released and moved in either the upward or downward direction relative to the retainer